REMARKS

Present Status of the Claims

Claims 1, 3-7, 9-12, 14, 16-20 and 22-25 are pending after entry of the amendment. Claims 2, 8, 13, 15, 21 and 26 were previously cancelled. No amendments to the claims have been made. Thus, no new matter has been added.

Reconsideration of the application is respectfully requested.

Interview Summary

Applicants would like to thank the Examiner and the Primary Examiner for the time during the interview on January 18, 2011. During the interview, the Examiner requested clarification of Figs. 3 and 4. In this respect, a clear version of Figs. 3 and 4 is provided in this Reply. The Interview Summary substantially reflects the substance of the interview.

Issues under 35 U.S.C. § 103(a)

Claims 1, 3-7, 9-12, 14, 16-20 and 22-25 stand rejected under 35 U.S.C. §103(a) as being obvious over Nakamoto (US 2002/0060514), Ruoff et al (US 5547748), Lieber et al (US 6159742), Iwamura et al (US 2002/0061397) and Smalley (US 2002/0127171). This rejection is respectfully traversed.

The Present Invention

Claim 1 of the present invention is directed to a carbon nanocapsule thin film, prepared by electroplating a plurality of carbon nanocapsules onto a substrate, wherein the carbon nanocapsules comprise a functional group and the functional group carries at least one charge after dissociation, and the carbon nanocapsule is a polyhedral carbon cluster constituted by having concentric multi-layers of closed graphitic sheet structure and the diameter of the carbon

nanocapsule is about 3-100 nm, and the carbon nanocapsule thin film has no metal material between the carbon nanocapsules.

Claim 14 of the present invention is directed to a carbon nanocapsule thin film preparation method, comprising: providing a substrate; and electroplating a plurality of carbon nanocapsules onto the substrate, wherein the carbon nanocapsules comprise a functional group and the functional group carries at least one charge after dissociation, the carbon nanocapsule is a polyhedral carbon cluster constituting multiple graphite layers having a balls-within-a ball structure, and the diameter of a carbon nanocapsule is 3-100 nm, and wherein the carbon nanocapsule thin film has no metal material between the carbon nanocapsules.

Distinctions over the Cited References

Nakamoto, Ruoff, Lieber, Iwamura and Smalley fail to suggest or disclose that a carbon nanocapsule thin film prepared by electroplating a plurality of carbon nanocapsules onto a substrate has no metal material between the carbon nanocapsules.

However, independent claims 1 and 14 clearly identify that a carbon nanocapsule thin film prepared by electroplating a plurality of carbon nanocapsules onto a substrate has no metal material between the carbon nanocapsules and a preparation method thereof, respectively.

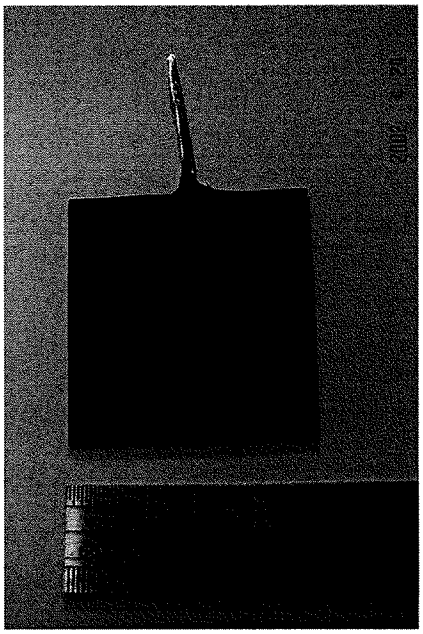
As disclosed in the Embodiment of the present specification, the carbon nanocapsules with -COOH groups bonded thereon were dispersed into an electroplating solution of NaCl(aq)(0.1M). A silver electrode was disposed in the electroplating solution as an anode and a platinum electrode was disposed in the electroplating solution as a cathode. The –COOH group bonded on the carbon nanocapsules carried at least one negative charge after dissociation in the electroplating solution, such that the functionalized carbon nanocapsules carried at least one negative charge were electroplated onto the anode to form the carbon nanocapsule thin film without metal material between the carbon nanocapsules.

Also, one skilled in the art should appreciate that metal ions dissolved in the electroplating solution carry positive charges, such that the metal ions cannot be reduced into metal and cannot be electroplated onto the anode.

Further, even though the metal ions dissolved in the electroplating solution carry positive charges, the metal ions are difficult to reduce and electroplate onto the cathode. A skilled artisan should appreciate that the metal ions used for an electrolyte in the electroplating solution are difficult to reduce into a metal because the reduction potential thereof is high. Thus, when the functionalized carbon nanocapsules of the present invention carrying at least one positive charge were electroplated onto the cathode to form the carbon nanocapsule thin film, the metal ions dissolved in the electroplating solution carrying positive charges are difficult to reduce and electroplate onto the cathode.

Moreover, as disclosed in the Embodiment of the present specification, the carbon nanocapsule thin film was electroplated onto the silver electrode, as shown in Fig. 3, using a current of 1A and a voltage of 1.3V for 10 minutes. As disclosed in a reference book of electrochemistry, *Donald T. Sawyer et. al. Electrochemistry for chemists 2nd. Wiley-Interscience Publication, 1995, Page 16.*, (see the Attachment), the reduction potential of Na^+ ion is -2.7V. Accordingly, the voltage of 1.3V used in the Embodiment of the present invention cannot cause the Na^+ ions to reduce and electroplate onto the electrode.

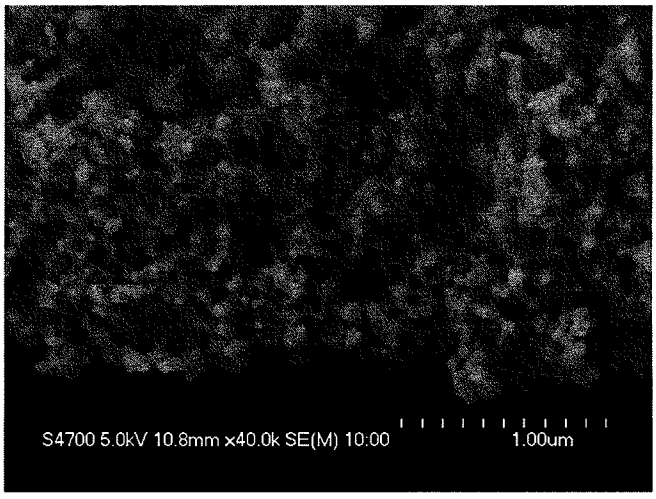
The actual copy of Fig. 3 is shown as below:



As shown in Fig. 3, after performing the electroplating process for 10 minutes, a black carbon nanocapsule thin film was formed on the silver electrode. The black color is the primary color of the carbon nanocapsule thin film. Because the primary color of Na metal is silver, if there was a metal binder between the carbon nanocapsules of the thin film, the thin film would be gray in color. Thus, Fig. 3 of the present specification proves that the carbon nanocapsule thin film of the present invention has no metal material (e.g., Na) between the carbon nanocapsules.

As disclosed in the Embodiment of the present specification, the carbon nanocapsule thin film on the silver electrode was observed under a scanning electron microscope (SEM), as shown in Fig. 4.

The actual copy of Fig. 4 is shown as below:



As shown in Fig. 4, the carbon nanocapsules were stacked together to form the carbon nanocapsule thin film. There was no metal binder disposed in or on the carbon nanocapsule thin film. One skilled in the art should appreciate that a metal plating layer would have a flat and dense surface. Thus, Fig. 4 of the present specification further proves that the carbon nanocapsule thin film of the present invention has no metal material between the carbon nanocapsules.

Accordingly, the carbon nanocapsule thin film of the present invention, which is prepared by electroplating a plurality of carbon nanocapsules with functional groups onto a substrate, has no metal material between the carbon nanocapsules.

Furthermore, the electroplating solution of the present invention may be prepared by a non-metal electrolyte, such as $NH_4^+OH^-$, $NH_4^+Cl^-$, $N(C_2H_5)_4^+Cl^-$, $P(Ph)_4^+Br^-$, etc, or a metal electrolyte, such as NaCl, KCl or KBr, etc, which are known by one skilled in the art. NaCl used in the Embodiment of the present invention is not a unique feature to the present invention. The metal ions used as an electrolyte in the electroplating solution have a high reduction potential, such that the metal ions, for example Na^+ and K^+, are difficult to reduce into metal and electroplate onto the electrode. In other words, any metal hypothetically reduced from the metal ions used in the electrolyte in the electroplating solution is unstable. Even though the metal ions of the electrolyte are reduced into metal, the metal is easily to be oxidized into metal ions. Therefore, the metal of the electrolyte is not available as a bonding material between the carbon nanocapsules. Thus, even the functional group bonded on the carbon nanocapsules carries at least one positive charge after dissociation in the electroplating solution, and the carbon nanocapsule thin film formed on the cathode has no metal material between the carbon nanocapsules.

As disclosed in paragraphs [0063]-[0064] of Nakamoto, nickel sulfate, sodium phosphinic acid, sodium acetate, sodium citric acid and boric acid were dissolved in distilled water to form a plating solution. Although the plating solution of Nakamoto contains sodium ions, the metal plating layers 42 and 46 of Nakamoto are formed from an electroless Ni-B-P based resistance plating layers and have no sodium metal. During the plating process of Nakamoto, the fullerenes or carbon nanotubes are precipitated with the metal plating layers 42 and 46. Accordingly, Nakamoto fails to teach or suggest a carbon nanocapsule thin film without metal material between carbon nanocapsules.

Further, in one aspect of the carbon nanocapsule thin film of the present invention, a covalent bonding is formed between the carbon nanocapsules through a [2+2] cycloaddition, such that the carbon nanocapsule thin film electroplated onto the anode does not require a metal material disposed between the carbon nanocapsules as a binder.

In contrast, as disclosed in claim 1, paragraphs [0064], [0071-0072] and Figs. 3-5, 7B-7C of Nakamoto, the fullerenes or carbon nanotubes for forming the micro-bodies 44 and 48 need to be precipitated together with the metal plating layers 42 and 46 on the cathode electrode 22 and gate electrode 24 by a metal reduction of the metal plating layer during an electroplating process to form a thin film of the emitters for a filed emission cold cathode device. Indeed, the thin film of the emitter of Nakamoto requires the metal plating layer as a binder disposed between the carbon nanotubes. Moreover, the thin film of Nakamoto including the fullerenes or the carbon nanotubes is not electroplated onto the anode 68. The thin film of Nakamoto is electroplated onto the cathode electrode 22 and gate electrode 24 for performing the metal reduction of the metal plating layer.

As disclosed in the abstract and the paragraphs [0032] and [0043] of Smalley, a means for producing high-purity single-wall carbon nanotube material is provided to remove metal-containing residual catalyst particles and amorphous carbon by a gas-phase oxidation of the amorphous carbon and a liquid-phase reaction of a halogen-containing acid with the metal-containing species.

Thus, through the combination of the disclosures of Nakamoto and Smalley, the fullerenes or the carbon nanotubes of Nakamoto are purified by the means of Smalley before being precipitated together with the metal plating layers 42 and 46, or the metal plating layers 42 and 46 in the thin film of Nakamoto are removed by the means of Smalley and failed to form a carbon nanocapsule thin film. Accordingly, Nakamoto and Smalley fail to teach or suggest that a carbon nanocapsule thin film, which is prepared by electroplating a plurality of carbon nanocapsules onto a substrate, has no metal material between the carbon nanocapsules.

Furthermore, the carbon nanocapsule thin film of the present invention has an unexpected effect on chemical resistivity. As disclosed in page 7, lines 7-10 of the present specification, the carbon nanocapsule thin film is not degraded after placing in royal water for 1 minute. However, if metal materials are mixed between the carbon nanocapsules in a thin film, such as the thin film of the emitter of Nakamoto, the thin film is degraded after placing in royal water. This is one proof that the carbon nanocapsule thin film of the invention has no metal material between the

carbon nanocapsules. Thus, the carbon nanocapsule thin film of the invention has good chemical resistivity to protect the metal disposed under the carbon nanocapsule thin film.

Lastly, Ruoff, Iwamura and Lieber also fail to teach or suggest that a carbon nanocapsule thin film prepared by electroplating a plurality of carbon nanocapsules onto a substrate, has no metal material between the carbon nanocapsules. Accordingly, Nakamoto, Ruoff, Iwamura, Lieber and Smalley fail to teach or suggest the limitation of "the carbon nanocapsules thin film has no metal material between the carbon nanocapsules" recited in claims 1 and 14, Applicants therefore believe that claims 1 and 14 are novel and non-obvious over Nakamoto, Ruoff, Iwamura, Lieber and Smalley individually or in combination.

Insofar as claims 3-7, 9-12 depend from claim 1 and claims 16-20 and 22-25 depend from claim 14, these claims are also allowable at least by virtue of their dependency.

Reconsideration and withdrawal of the obviousness rejection are respectfully requested.

Conclusion

Applicants believe that this application is in condition for allowance.

Should there by an outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Craig A. McRobbie, Registration No. 42,874 at the telephone number of the undersigned below to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Director is hereby authorized in this, concurrent, and future replies to charge any fees required during the pendency of the above-identified application or credit any overpayment to Deposit Account No. 02-2448.

JAN 3 1 2011

Dated: _____

Respectfully submitted,

By _____

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Attachment: Excerpted part of electrochemistry book

Attachment

TABLE 1.3 Nucleophilicity and Electrophilicity of Molecules and Ions[a]

Nucleophile	$(E_{1/2})_{ox}$, V vs. NHE (MeCN)	$(E_{1/2})_{ox}$, V vs. NHE (H_2O)	Electrophile	$(E_{1/2})_{red}$, V vs. NHE (MeCN)	$(E_{1/2})_{red}$, V vs. NHE (H_2O)
e^-_{aq}	−3.9	−2.9	$H_2O^+\cdot$	+3.2	+2.7
K·	−2.9	−2.9	$Ph^+\cdot CH_2OH$	+2.2	
Na·	−2.1	−2.7	Au^+	+1.6	+1.8
Li·	−2.0		$(Cl_8TPP^+\cdot)Fe^{IV}=O$ (compound I)	+1.5	
$(TPP^-\cdot)Co^-$	−1.7				
H·	−1.6	−2.1	$Fe^{III}(bpy)_3^{3+}$	+1.3	+1.1
$(TPP^-\cdot)Fe^-$	−1.4		HO·	+0.9	+1.9
$(TPP)Fe^-$	−0.8		$Fe^{III}(PA)_3$	+0.4	
$(TPP)Co^-$	−0.6		$(TPP)Fe^{III}(py)_2^+$	+0.4	
$O_2^{-}\cdot$	−0.7	−0.2	$(TPP)Fe^{III}Cl$	+0.2	
$PhCH_2S^-$	0.0		MV^{2+}	−0.2	
HOO^-	0.0	+0.7	$(Cl_8TPP)Fe^{IV}=O$ (compound II)	−0.3	
PhO^-	+0.3				
Me_3N	+0.7		AQ (anthraquinone)	−0.6	
HO^-	+0.9	+1.9	O_2	−0.7	−0.2
$MeC(O)O^-$	+1.5		CCl_4	−0.9	
PhOH	+1.7		$PhCH_2Br$	−1.4	
pyridine	+2.0		$PhCl_6$	−1.4	
Cl^-	+2.2	+2.4	H_3O^+	−1.6	−2.1
HOOH	+2.3	+1.0	*t*-BuI	−1.5	
H_2O	+3.0	+2.3	$PhCH_2Cl$	−1.7	
			n-BuI	−1.9	
			c-$C_6H_{11}Br$	−1.9	
			t-BuBr	−2.0	
			n-BuBr	−2.2	
			n-BuCl	−2.5	
			PhCl	−2.6	
			H_2O	−3.9	−2.9

[a]Strongest or most reactive at top of listing.